DEVELOPMENT OF A WATER QUALITY MONITORING PROGRAM FOR THE BIG THICKET NATIONAL PRESERVE, TX

WATER
RESOURCES
FIELD
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LABORATORY

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NATIONAL PARK SERVICE
Department of the Interior

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INTRODUCTION

The Big Thicket National Preserve (BITH), consists of 84,550 acres divided into 12 management units. Eleven units of the preserve including the Beech Creek Unit, Upper Neches River Corridor Unit, Neches Bottom and Jack Gore Baygall Unit, Lower Neches River Corridor Unit, Beaumont Unit, Little Pine Island Bayou Corridor Unit, Lance Rosier Unit, Loblolly Unit, Hickory Creek Savannah Unit, Big Sandy Creek Unit, and Turkey Creek Unit are contained within the Neches River watershed while the Menard Creek Corridor Unit drains into the Trinity River Basin. Like most surface waters of southeastern Texas, the streams/ rivers have a very dilute soft water chemical character and are exceedingly variable in seasonal discharge.

The majority of major water courses in BITH have headwaters outside the preserve. Compounding this, many small creeks and tributaries which flow into NPS waters serve as drainage channels for adjacent properties (Fig. 1). Land use activities which may influence water quality within the waters of the preserve include:

1) Oil field activities including watershed disturbances associated with the development of drilling pads, service roads and seismic lines; the use of herbicides in the maintenance of right of ways; the potential contamination of water by surface spills from storage areas and pipelines, and the leaching/ overflow of drilling mud pits and oil field brine disposal ponds.

2) Timber operations which include harvesting and clearcutting along the preserve perimeter and the use of pesticides in forest management.

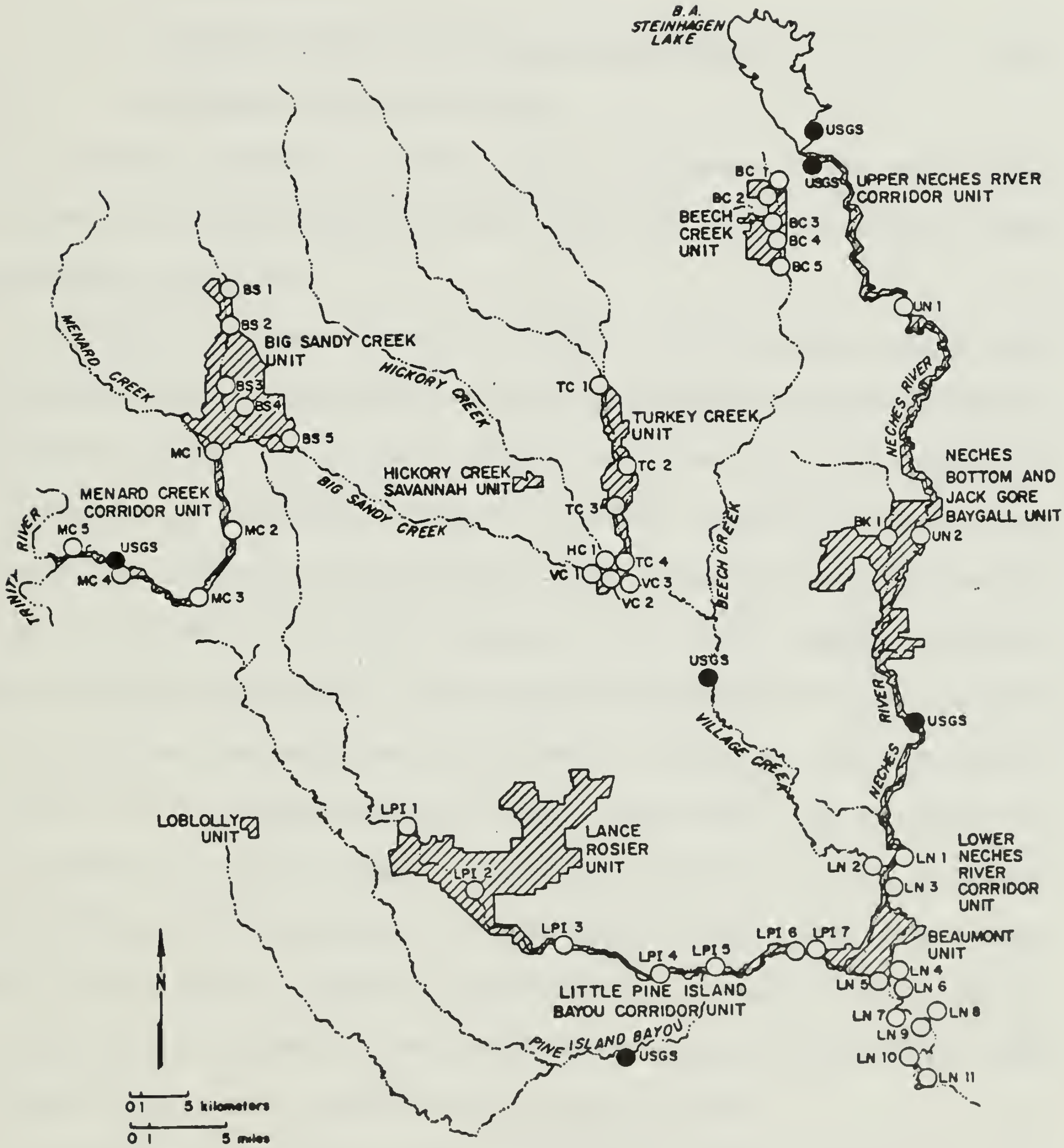

Figure 1. Map of Big Thicket National Preserve with historical and proposed water quality monitoring sites.

3) Discharge of sewage treatment plant effluent into Turkey Creek, Little Pine Island Bayou and Pine Island Bayou.

4) Increasing housing and recreational development along the corridor units.

5) Potential runoff of herbicides/insecticides used in timber management and rice farming.

For the purposes of water quality management, the major water courses of the Big Thicket National Preserve can be divided into three management categories.

Category 1 waters consists of those stream segments whose water quality presently ranges from very good to excellent and which should be accorded highest protection priority including the establishment of nondegradation standards. Category 1 waters include Big Sandy Creek, Beech Creek, Turkey Creek and Black Creek. Especially sensitive at this time is Big Sandy Creek which because of its dilute chemical character and watershed topography is especially susceptible to water quality deterioration from watershed disturbance. Recent oil drilling activities in the Alabama-Coushatta Indian Reservation and proposed oil activities in the Big Sandy Creek Unit itself, as well as timber harvesting and clearcutting to the preserve boundary constitute immediate water quality threats. Additionally, proposed intensive oil exploration/operations in the Neches Bottom and Jack Gore Baygall Unit target this area for immediate water quality concern.

Management action for category 1 waters should include the rapid (summer, 1984) implementation of a long-term water quality monitoring network and an evaluation of the need for intensive (short-term) water quality studies at especially sensitive drill sites. These short-term

studies could be incorporated at reasonable cost as part of the permitting requirements at selected drill sites.

Category 2 waters consists of those stream segments already exhibiting water quality degradation for one or more parameters, often because of permitted, legal point source discharges and nonpoint source pollution. These waters include Little Pine Island Bayou which has long been impacted by oil field brines in the Saratoga and Sour Lake areas and the permitted discharge of sewage treatment plant effluent from Pinewood Estates and possibly Bevil Oaks and Lumberton. Also included is Menard Creek, where Harrel and Bass (1979) have reported elevated bacterial counts and which may be influenced by runoff from upstream rice farming.

Water quality management strategy for category 2 stream segments should include documentation of the extent of water quality degradataion and an impact inventory and assessment of all point source and nonpoint source contributing to the water quality problem. A water quality monitoring network, similar to, but less intensive than that planned for category 1 waters should also be implemented.

Category 3 waters are those major stream segments that flow through BITH which are included in the <u>Texas Surface Water Quality Standards</u> (1980) and which are routinely monitored by the United States Geological Survey (Table 1). These stream segments include the Neches River from the tidal zone to the Town Bluff Dam (segment 0602), Pine Island Bayou (segment 0607), and Village Creek (segment 0608).

These major river/stream segments have large watersheds and significant stream reaches outside of the preserve. Thus, overall stream water quality cannot be substantially influenced by park management. Water quality standards for these stream segments have been

Table 1. Texas State Quality Standards (1980) for stream segments within Big Thicket National Preserve.

Neches River (segment 0602): above tidal and below Town Bluff Dam (at base flow condition)			
Chloride	50 mg ℓ^{-1}	pH range	6.0 - 8.5
Sulfate	30 mg ℓ^{-1}	Fecal coliform	200/100 ml
Total Dissolved Solids	150 mg ℓ^{-1}	Dissolved Oxygen	greater than 5.0 mg ℓ^{-1}
Oil and Grease	0	Temperature	91°F
Pine Island Bayou (segment 0607):			
Chloride	150 mg ℓ^{-1}	pH Range	6.0 - 8.5
Sulfate	50 mg ℓ^{-1}	Fecal coliform	200/100 ml
Total Dissolved Solids	300 mg ℓ^{-1}	Dissolved Oxygen	greater than 5.0 mg ℓ^{-1}
Oil and Grease	0	Temperature	95°F
Village Creek (segment 0608):			
Chloride	150 mg ℓ^{-1}	pH Range	6.0 - 8.5
Sulfate	75 mg ℓ^{-1}	Fecal coliform	200/100 ml
Total Dissolved Solids	300 mg ℓ^{-1}	Dissolved Oxygen	greater than 5.0 mg ℓ^{-1}
Oil and Grease	0	Temperature	90 °F

determined by the State of Texas (Table 1). However, Texas standards allow for the implementation of nondegradation criteria for waters in national parks and other significant areas. If this designation applies to the waters of Big Thicket National Preserve, management strategy should include an assessment of present water quality, and if sufficient data are available, some type of statistical trend analysis. In addition, park management should assure that oil exploitation activity in the Neches Bottom and Jack Gore Baygall Unit and the Beaumont Unit does not degrade the water quality in these segments.

OBJECTIVES AND PROPOSED PLAN OF WORK

The overall objectives for the implementation of a water quality monitoring program and management plan for the Big Thicket National Preserve includes:

1) Establishment of baseline water quality for physicochemical, bacteriological and biological parameters for significant stream segments flowing through the preserve.
2) Development of nondegradation water quality standards for the various categories of water to be used in the planning/permitting process.
3) Implementation of a cost effective and efficient water quality monitoring program, capable of detecting major changes in water quality trends.
4) Establishment of an in-house computer data base of water quality measurements taken within the preserve for retrieval, comparison and future statistical analysis.
5) Identification of research needs to determine the localized impact on water quality of oil/gas exploration and drilling.

In order to accomplish this, within the constraints of present personnel and funding availability, a three-phase work plan extending over FY84 and FY85 is suggested.

PHASE I: Assessment of available water quality information

While the preserve is fortunate in having a large amount of water quality data from most of its major water courses, the information has been collected by a number of agencies and individuals. Harrel and his students have conducted a number of very important intensive studies in most of the major streams in the preserve (Fig. 2). Other monitoring has been conducted at various times by the Texas Water Quality Board, the Beaumont Water Pollution Surveillance Program, the United States Geological Survey and the Lower Neches Valley Authority. Additional studies published by Lewis (1974), Bass (1979), Freese et al. (1967), Patterson (1971), Ashcraft (1973), Howard (1973) and others have addressed water quality in various portions of the preserve. A bibliography of water quality and hydrological studies completed in BITH is attached (Attachment 1).

At this time, the water quality data base for BITH, while extensive, is fragmented and not available to park managers in a readily usable form. The objective of Phase I is the consolidation, analysis and interpretation of the available water quality information in a manner that will begin to define baseline water quality for the various stream segments and further define those areas needing additional monitoring or research. It is proposed that Phase I research begin immediately, with FY84 priority given to category 1 and category 2 stream segments. A companion report would be completed in FY85 for the category 3 stream segments. In addition, it is suggested that the

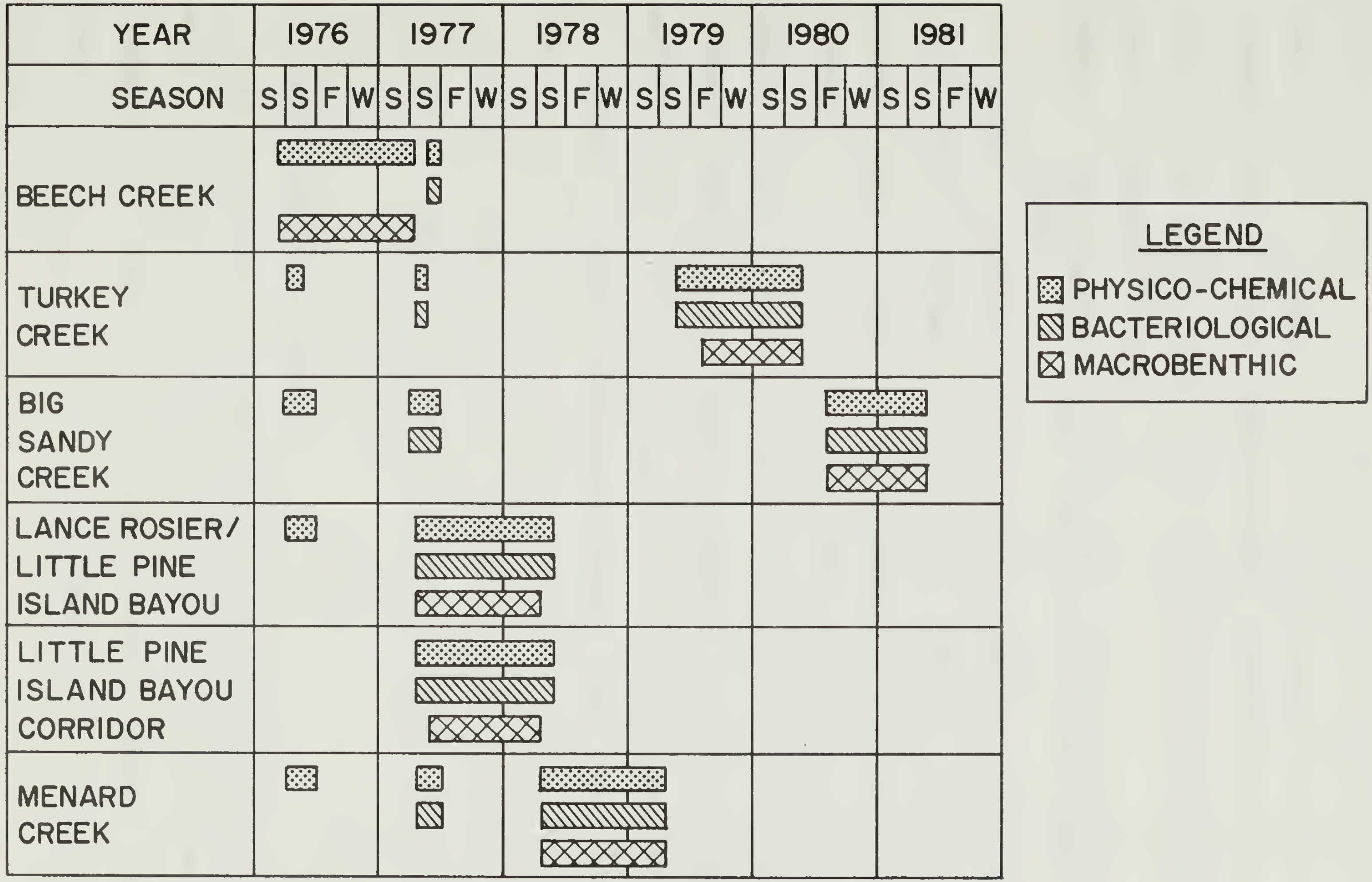

Figure 2. Historical physico-chemical, bacteriological and macrobenthic invertebrate studies in the major stream units of Big Thicket National Preserve, TX.

resource management staff of BITH, in cooperation with the staff of WRFSL establish a computer compatible water quality data base and data processing scheme for the in-house updating and analysis of previous and proposed water quality data. It is felt that this processing system could be implemented by FY85.

PHASE II: <u>Development of a fixed station water quality monitoring network</u>

In order to adequately assess both the impact of oil/gas development and watershed disturbance, and to detect changes in long-term water quality trends in BITH, it will be necessary for park management to establish a routine fixed station water quality monitoring network. Design criteria for any such network must justify station selection, parameters monitored and sampling frequency. For such a design to be implemented effectively, planning must also consider personnel training and availability, and funding restrictions. While a definitive design of a fixed station monitoring network can not be made until the completion of Phase I analysis, enough is known of the water quality situation of BITH to suggest an initial monitoring network which should be implemented as soon as possible.

A. <u>Station Selection/Frequency</u>

While final station selection should be deferred until the Phase I analysis of data is completed, a preliminary list of proposed stations is presented in Table 2. Most of these stations are ones selected and utilized by Harrel, the USGS and others, which will allow for continuity of data collection.

Initially, station selection is prioritized towards category 1 streams which currently have the most desirable water quality and the greatest susceptibility to water quality degradation. All category 1

Table 2. Preliminary fixed station water quality monitoring locations in the Big Thicket National Preserve, TX.

Category 1 streams: All stations to be monitored 4 times per year (seasonally) for physicochemical and bacteriological parameters and monthly for field survey parameters.

Big Sandy Unit:
- BS-1
- BS-3
- BS-5

Beech Creek Unit:
- BC-1
- BC-5

Turkey Creek Unit (including Hickory Creek and Village Creek):
- TC-1
- TC-3
- HC-1
- VC-1

Jack Gore Baygall Unit (Black Creek)
- Bk C-1

Total: 10 stations

Category 2 streams: All stations to be monitored 2 times per year (rising water and falling water hydrological conditions) for physicochemical and bacteriological parameters. All contact recreation locations should be monitored biweekly during recreational season for bacteriological parameters. Field parameters should be surveyed monthly.

Lance Rosier Unit:
- LPI-1
- LPI-2

Little Pine Island Corridor Unit:
- LPI-3
- LPI-5
- LPI-7

Menard Creek Corridor Unit:
- MC-1
- MC-4
- MC-5

Total: 8 stations

Category 3 streams: All stations to be monitored 2 times per year for field, physicochemical and bacteriological parameters.

Upper Neches River Corridor Unit:
- UN-1
- UN-2

Lower Neches River Corridor Unit/Beaumont Unit:
- LN-1
- LN-2
- LN-4
- LN-6

Total: 6 stations

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streams are to be sampled seasonally, four times per year, the minimum sampling frequency designated by the Texas Surface Water Quality Standards (1980), as part of a routine fixed station monitoring program. More frequent (monthly) field parameter surveys including water level, temperature, specific conductance, dissolved oxygen, turbidity, pH should be implemented by park staff.

Category 2 streams should receive routine fixed station monitoring a minimum of two times per year (during rising water and falling water hydrological conditions) with the exception of bacterial analysis. Bacterial analysis should occur biweekly at locations popular for contact recreation during those months of probable recreational usage. In addition, monthly field parameter surveys should be completed in the Lance Rosier/Little Pine Island Bayou stations at the same time category 1 streams are surveyed.

Category 3 stream monitoring is accomplished primarily by other agencies. Liasion with these agencies should be established in order to facilitate transfer of important water quality information to BITH staff. In addition, twice a year supplemental monitoring at the five stations listed in Table 2 should be implemented.

B. Water Quality Parameter Selection

Like station selection, final parameter selection should be completed after Phase I analysis. Parameter selection is generally dependent upon the type of water quality concerns, based upon both actual and suspected watershed impacts.

Most commonly, water quality criteria (such as those for the State of Texas) are based largely on physical, chemical and bacteriological parameters, since these are easily defined. The problem with this approach is that the chemical substances which affect the quality of

water are numerous, act over a great range of concentrations, and vary continuously and erratically in concentration. Thus chemical surveys indicate stream conditions only at the times of sampling, and occasional spills of highly concentrated wastes are not easily detected (Wilhm and Dorris, 1968).

Keup et al. (1966) stated that the analysis of macrobenthic organisms are useful for water quality studies because: (1) they have long life cycles which reflect conditions for an extended period of time, (2) they display low motility, (3) they have various ranges of tolerances to varying environmental conditions, and (4) they occupy central positions in the aquatic food chain. Many researchers have used benthic macroinvertebrate data in mathematical indices to analyze the relationship between water quality and community structure. The Shannon Diversity Index ($\bar{d}$) (Shannon, 1948) is probably the most widely accepted of these indices. Low $\bar{d}$ values (less than 1) indicate few taxa and unfavorable water quality conditions while high $\bar{d}$ values (greater than 3) indicate many taxa and good water quality conditions.

Harrel and his students have contributed greatly to the knowledge of the community structure of the benthic macroinvertebrates in most of the major waters of the preserve. While this information provides a valuable baseline and is of importance to synoptic intensive surveys assessing the localized impact of various disturbances, it does not replace the need for the implementation of a fixed station water quality monitoring network. Difficulties with the routine use of the benthic macroinvertebrate approach include:

1) Discharge dependence: Wash in of taxa from tributaries and scouring of other taxa from sampling locations during periods

Table 3. Suggested field, physicochemical and bacteriological monitoring for a fixed station water quality monitoring program.

Group	Parameter	Reason
Field parameters	water level	discharge relationship
	water temperature	aquatic life
	specific conductance	oil field brines, STP effluent
	turbidity	erosion
	pH	aquatic life
	dissolved oxygen	aquatic life, organic loading
Physicochemical parameters	alkalinity	buffering capacity
	chlorides	oil field brines
	sulfate	atmospheric deposition, anion balance
	total dissolved solids	oil field brines, STP effluent
	total suspended solids	erosion
	oil/grease	oil spills
	color	aesthetics, photosynthetic activity
Bacteriological parameters	fecal coliform	septic leakage, public health
	fecal streptococcus	livestock/wildlife contamination
Discharge	discharge measurements	flow adjusted water quality

of high discharge influence diversity and make interpretation difficult.

2) Substrate variability: Most taxa display distinct substrate preference. The variability of substrates from sand to silts and clays throughout the Big Thicket complicates areal assessment utilizing diversity indices.

3) Professional assistance: Species identification to the level accomplished in the studies of Harrel and his students requires specialized graduate training, not always readily available to park management. While the use of such techniques are of value on a short-term intensive study basis, personnel changes, etc. make them difficult to implement as part of a long-term fixed station program.

Thus, the fixed station water quality monitoring program (Table 3) recommended for Big Thicket National Preserve relies primarily upon the collection of field parameters (water level, water temperature, specific conductance, turbidity, pH and dissolved oxygen) which can be routinely measured by specially trained park staff, and physicochemical parameters (alkalinity, chlorides, sulfate, total dissolved solids, total suspended solids, oil and grease) and bacteriological parameters which can be analyzed by local laboratories and contractors. Macrobenthic analysis, however can be a valuable addition to this work when applied as part of intensive, limited duration studies to assess specific water quality problems (Phase III).

PHASE III: Identification of short-term, intensive water quality research needs

Many impact related water quality questions require research above and beyond that normally afforded by routine fixed station monitoring

networks. A good example of this is some of the Harrel studies which involved physicochemical and bacteriological sampling monthly to supplement bimonthly benthic macroinvertebrate sampling. The man power requirements and costs associated with carrying out this type of sampling frequency, at all stations over a long period of time is prohibitive. However, well planned and executed intensive studies, designed to answer specific questions over a limited time frame will be necessary to answer some of the impact related questions at BITH.

Again, it is not possible at this point to focus on priorities and costs of these studies. Each will be specifically designed to answer specific management related questions. However, park management, in reviewing permit requests etc. should ask if any new or immediate impacts will be caused by individual or cumulative activities, and if so, require intensive studies to assess these impacts. Some examples of issues of concern to water quality management may include:

1) Lysimiter studies to measure the extent of leaching of brines and oil compounds from mud pits/brine holding areas into the soil and groundwater under varying soil regimes.

2) Upstream/downstream impact studies on macroinvertebrates and water quality from drilling operations at especially susceptible sites.

Many of these types of studies could be incorporated as substudies in major research projects, such as the impact study proposed by Stephen F. Austin University. In addition, the local proximity and fine previous studies of Dr. Harrell, make Lamar University an excellent resource for this type of work.

Timetable/Approximate Costs

A phased approach was utilized in developing a water quality program for Big Thicket National Preserve in order to allow park management the greatest flexibility in the selection of options. This section discusses approximate costs and suggests a timetable for the implementation of the various options.

The major costs, personnel commitments and funding requirements for the implementation of Phase I are presented in Table 4. This component, which includes the compilation, analysis and authorship of two historical reports (one in FY84; a second in FY85) is funded and sponsored jointly under the technical assistance program of the Water Resources Field Laboratory ($10,000), and BITH/SWRO though a commitment totalling $6650 in salaries, contracts and travel.

Major commitments for the implementation of Phase II are sought from BITH, in terms of the man power necessary to implement a water quality program and from SWRO in order to fund the purchase of necessary capital equipment and laboratory costs.

Table 5 presents a cost comparison between in-house and contractor implementation of a field parameter monitoring network. The costs of purchasing the equipment and training the personnel necessary to operate the simple field tests is approximately $4965 in the first year. Subsequent annual costs in training and supplies would be approximately $2700 per year. This compares favorably to having the work done by an outside contractor at a published price of $5640 per year. In addition, the availability of equipment in the park would allow a more rapid response to an emergency situation.

Table 4. Approximate cost, personnel committment and funding source for Phase I implementation.

Activity	Personnel Committment	BITH/SWRO Funding	WRFSL Funding
Compile, analyze and publish historical report on water quality in category 1 and category 2 (FY84)	Hydrologist GS-12 (4.0 pay periods)		$4500
	Student Assistant (200 hrs)	$1050	
	Drafting/Typing		$500
	Site visit to review agency and files, arrange data transfer, etc.	$700	
Compile, analyze and publish a historical report on water quality of category 3 streams (FY84-85)	Hydrologist GS-12 (3 pay periods)		$3500
	Student Assistant (200 hours)		$1050
	USGS trend analysis, statistical summary and letter report	$2000	
	Drafting/Typing		$ 450
Establish computer compatible data base management scheme for archiving and retrieval of water quality data	Computer Specialist GS-11 (3.0 pay periods)	$2900	
	Total	$6,650	$10,000

Table 4. continued.

Phase I Budget Summary:

		BITH/SWRO	WRFSL
FY84	Salaries	$3950	$5100
	Travel	$700	0
	Supplies/Services	0	$500
	Contracts	$2000	0
		$6650	$5600
FY85	Salaries	$ 0	$4100
	Supplies/Servies	$ 0	$300
		0	$4400

Table 5. Cost comparison for in-house (NPS) determination of field parameters vs. contracting field parameter analysis to Sabine River Authority

A. In-house cost of field monitoring equipment for water temperature, specific conductance, turbidity, pH and dissolved oxygen for NPS field survey (estimate life of capital equipment = 4 years).

Capital Equipment

YSI Model 33 S-C-T meter with combination probe	temperature/conductance	$550.00
Orion Model 221 pH meter with probe	pH	$375.00
Orion 9708 Dissolved Oxygen probe for use with Model 221	dissolved oxygen	$495.00
Turner Designs Nephelometer Model 40-100	turbidity	$845.00
Spare parts and probes		$300.00
	Total	$2565.00

Annual Costs

Park Technician (GS-5) 30 days/year	$1800.00
Ground transportation (10 trips x 300 mi = 3000 mi @ $0.20/mile)	$600.00
First year cost	$4965.00
Subsequent year costs (includes $300/yr for expendible supplies)	$2700.00

Table 5. continued

B. Contracted cost of field parameter survey (assuming 10 per year) for water temperature, specific conductance, turbidity, pH and dissolved oxygen by Sabine River Authority at 18 category 1 and category 2 stations (180 sites/year)

Capital Equipment		$ 0
Annual Lab Analysis		
Water temperature	NC x 180	$3240.00
pH	$3.00 x 180	
turbidity	$6.00 x 180	
Sp. conductance	$4.00 x 180	
Dissolved oxygen	$5.00 x 180	
Logistics		
Park Technician (GS-5) 30 days/year		$1800.00
Ground Transportation (10 trips x 300 mi = 3000 mi @ $0.20/mile)		$ 600.00
	Total	$5640.00

Table 6 establishes the annual laboratory costs for the physicochemical and bacteriological analysis needs for the implementation of a fixed station water quality monitoring network for BITH. The water quality tests completed here are beyond the present capability of the preserve staff and it is suggested that the analytical work be contracted to a local laboratory. Estimated annual costs for the analytical service is projected to be $5124.00. In addition, arrangements should be made for discharge analysis on major ungauged streams, and periodic assessments of nutrients, metals and pesticides at representative stations. A summary of Phase II implementation costs are presented in Table 7.

It is beyond the scope of this proposal to provide cost estimates for Phase III studies. However, it is suggested that park staff, regional staff and WRFSL staff work closely in the identification and implementation strategy of needed Phase III research requirements.

Travel dollars should be allocated in FY84 so that the opinion of specialists can be sought in the development of Phase III needs. After this initial planning stage, RFP's can be developed and advertised so that funds can be set aside for FY85-86.

Table 6. Annual laboratory costs for physicochemical and bacteriological analysis for a fixed station water quality monitoring network for Big Thicket National Preserve, TX.

Category 1 stations: 10 stations at 4 times per year = 40 sampling (except where noted).

Parameter	Cost per analysis	Annual Cost
Alkalinity	$ 3.00	$ 120.00
Chlorides	$ 6.50	$ 260.00
Sulfate (2x PER YEAR)	$ 8.00	$ 160.00
Total Dissolved Solids	$10.00	$ 400.00
Total Suspended Solids	$ 8.00	$ 320.00
Oil/Grease	$15.00	$ 600.00
Color (2x PER YEAR)	$ 6.50	$ 130.00
Fecal Coliform (2x PER YEAR)	$11.00	$ 220.00
Fecal Streptococcus (2x PER YEAR)	$13.00	$ 260.00
	Total	$2470.00
	Annual Cost per Station	$ 247.00

Category 2 stations: 8 stations at 2 times per year = 16 sampling (except where noted).

Parameter	Cost per analysis	Annual Cost
Alkalinity	$ 3.00	$ 48.00
Chlorides	$ 6.50	$ 117.00
Sulfate	$ 8.00	$ 128.00
Total Dissolved Solids	$10.00	$ 160.00
Total Suspended Solids	$ 8.00	$ 128.00
Oil/Grease	$15.00	$ 240.00
Color	$ 6.50	$ 117.00
Fecal Coliform plus extra recreational sampling (15)	$11.00	$ 341.00
Fecal Streptococcus plus extra recreational sampling (15)	$13.00	$ 403.00
	Total	$1682.00
	Annual Cost per Station	$ 210.00

Table 6. continued

Category 3 stations: 6 stations at 2 times per year = 12 samplings

Parameter	Cost per analysis	Annual Cost
Alkalinity	$ 3.00	$ 36.00
Chlorides	$ 6.50	$ 78.00
Sulfate	$ 8.00	$ 96.00
Total Dissolved Solids	$10.00	$ 120.00
Total Suspended Solids	$ 8.00	$ 96.00
Oil/Grease	$15.00	$ 180.00
Color	$ 6.50	$ 78.00
Fecal Coliform	$11.00	$ 132.00
Fecal Streptococcus	$13.00	$ 156.00
	Total	$ 972.00
	Annual cost per station	$ 162.00
	Total Lab Analysis cost (per year)	$5124.00

Table 7. Approximate cost and funding sources for Phase II implementation.

Activity	Personnel Commitment/Cost		Source
Establish in-house field monitoring program, field	Capital equipment (4 yr life)	$2565.00	SWRO
	Park Technician (30 days/year) transportation	$1800.00	BITH
Contract physicochemical/ bacteriological lab costs, field sampling	Lab costs (annual)	$5124.00	SWRO
Periodic nutrient, metals and pesticide sampling at key stations	Lab costs (irregular)	$1200.00	SWRO
Data base maintenance	Computer specialist (24 days/year)	$2400.00	BITH
Estlishment of appropriate stream gaging sites for continuous/discontinuous flow information		$1200.00	SWRO
Field training, lab liasion, contracting, data review etc.	Hydrologist (WRFSL) (10 days/year)	$1200.00	WRFSL
	SWRO (3 days/year)	$ 350.00	SWRO
	Site visits	$1000.00	WRFSL/SWRO
	Total	$16,839.00	
	Funding: BITH/SWRO =	$15,139.00	
	WRFSL =	$ 1,700.00	

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APPENDIX I

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